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MIT: Shaping the Future

Inaugural Address, 10 May 1991

I was elected president of MIT in June 1990 and formally took office the following October 15. The inaugural ceremonies would not take place until May 1991, when the New England weather would permit us to convene in the great venue of Killian Court; I spent those months interviewing the MIT faculty and others, learning their views of what was needed for the Institute to go forward. The inaugural address was in some measure a distillation and shaping of their insights. It also contained several components that I felt were especially important for MIT, as an icon and leader of American science and technology, to address—the shrinking and rapid interconnection of our planet largely because of information technology, the increasingly apparent need to steward our environment on a global scale, the sorry state of much of public secondary education, and the continuing quest to bring people of color into the nation’s scientific and engineering workforce and leadership.

It seemed especially incumbent on MIT to take an active and visible role in rebuilding trust and investment in science and technology among the American public and the federal government, because at that time highly publicized claims of scientific misconduct had negatively affected the views of the public and of Congressional policymakers. Indeed, ameliorating this would turn out to be a constant personal quest during my tenure.

Finally, I chose as a theme “MIT: Shaping the Future,” to connote a university strongly dedicated to driving change in the world beyond its campus boundary, as well as purposefully directing its own institutional evolution.

This is, indeed, a splendid moment—as we gather to celebrate a great institution, to renew our commitment to a set of ideals, to

mark a passage, and to set a course for the future. Yet for me and for my family, it is also an intensely personal experience, and one that we are honored to share. A journey that began in a warm family in a small town in West Virginia has led to center stage in Killian Court—where my own path and that of the Institute have come together in this symbolic moment. It is a profound privilege to walk with four great and gracious men—Jay Stratton, Howard Johnson, Jerry Wiesner, and Paul Gray. Your trust and guidance give me great comfort and courage for the task ahead.

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On the banks of the Charles River an institution has arisen that is recognized throughout the world for its unique contributions to our life and times. Established one hundred thirty years ago this spring, MIT did not become yet another comprehensive university. Nor did it become simply an “engineering school” or a “polytechnic institute.”

Rather, it became a wellspring of scientific and technological knowledge and practice and a place where musical creativity thrives. Its inventive and entrepreneurial faculty generated a great economic engine, and they have created revolutionary insights into the structure of language and the nature of learning. They have led the quest to decipher the molecular foundations of life, and they have influenced the political and economic policies of nations. MIT’s engineers and scientists made critical contributions to our nation’s security when that was largely a military matter, and its graduates have given architectural manifestation to humankind’s highest cultural and artistic insights.

MIT has been home to distinguished scholars from around the world, men and women who have stretched the human mind and

spirit. Above all, it has provided an intense and effective education to generations of the brightest young men and women that this nation and the world have brought forth.

Now MIT prepares for the passing of the twentieth century and the advent of the twenty-first. We seek form and substance appropriate for these times, even as we seek to shape the future of our nation and world.

But we enter more than a new temporal era. We stand at the dawn of a new global age. Our lives are interwoven across national boundaries in unprecedented ways—connected through our earth’s environment, whose stewardship we all share; through our economic and production systems; through instantly shared information; through universally shared dreams. These dreams include the vision of a world in which the security of nations is defined by economic and social dexterity rather than by military might. And they include the vision of a nation that has regained its sense of social justice and is truly the land of opportunity for all.

MIT has played a remarkable role—at critical moments—in shaping our nation and our world. We have done so through individual creative genius and through grand institutional ventures. Like America itself, we have responded in a heroic and innovative manner to sudden challenges, such as the onset of World War II or the launching of Sputnik. Today we are challenged once again on a grand scale, but this time by slow, corrosive forces rather than by sudden, galvanizing events: by the erosion of our global environment rather than by explosions at Pearl Harbor; by declines in scientific literacy and industrial competitiveness rather than by the launching of a satellite.

This morning I would like to share with you my view of the challenges that confront us and to offer a growing vision of the opportunities they present for the future of MIT.

A New Global Age

There is a remarkable image etched in the mind and psyche of our generation. We were the first to view a shimmering, seemingly peaceful planet Earth from the depths of space. Still, here below, we know that we inhabit a raucous global village. We are connected, across time and space, as never before in human history. Many of these connections have been made possible by the advances in science and technology. We must learn to deal with this interdependence in new ways, creating new forms of organization and incorporating new points of view.

Let me give three examples.

First, the earth's environment, a fragile envelope that bears witness to the degrading effects of human activity. It is no longer possible, if it ever was, for individuals or nations to think that the way in which they treat their land, air, and water has no bearing on their neighbors. Nor is it possible for us to work on each aspect of this damaged environment as a separate problem. Ironically, many of the scientific and technological advances that so enhance human comfort and well-being—advances in transportation, energy, and agriculture—concurrently pose threats to our biosphere. This presents a challenge and an opportunity for us here at MIT. I believe that we must marshal our interests and capabilities to understand these issues and to develop solutions. Such an endeavor will require a new generation of scientific computation for atmospheric modeling, new instrumentation for monitoring environmental conditions, new modes of analysis, and new technologies to correct or avoid problems.

Beyond this, we need to come together in new ways—from different fields, different organizations, and different countries—to understand not only the physical but the cultural, economic, and political forces that affect the health of the natural world. The stage has been set at MIT by the establishment of the Center

for Global Change Science and by the new Council on the Global Environment. Only with this kind of integrated approach—drawing on faculty from disparate fields—can we hope to meet the profound challenge of making and keeping our planet livable.

Another challenge—and set of opportunities—in our increasingly inter-dependent world lies in the realm of electronic communication. Instantaneous communication, both verbal and visual, has reduced our planet to the electronic global village once envisioned by McLuhan. Knowledge has become a capital asset, at least as important as physical resources. Bits of information flowing through copper wires, optical fibers, or satellite links have become a new currency: the currency of the information marketplace. Increasingly, the commerce of this new marketplace will be conducted along fiber optic information superhighways that will connect computers, telephones, high-definition video systems, and hybrid technologies yet to be developed.

This information infrastructure already exists in rudimentary form. MIT has the opportunity to play a pivotal role in bringing increased capabilities and coherence to this system and in defining the currency of the new information marketplace. In doing so, we must not only increase the power and ease of computing and communications but we must do so in ways that enhance our intellectual and social capabilities, that help us make wiser decisions, and that enable us to bridge cultural and political barriers. Here, too, we must invent new ways of combining our talents across disciplinary and institutional boundaries in order to give form, substance, and humanity to the dawning information age. To this end, I am pleased to announce the establishment of the MIT Information Infrastructure Initiative—a project that will bring together eight different organizations within MIT with the goal of working with industrial partners to develop a very-high-frequency, entirely optical network and to establish within our campus a working model of the information marketplace.

My third example derives from the increasing political and economic connections throughout the world. These connections pose the question of whether the MIT of the future will be a national or an international institution. What does it mean for MIT to be a citizen of a world where common problems or interests are often more powerful than geographic distances, yet where national differences exist?

The issue is complex. MIT is a national institution, but America is no longer isolated. MIT was born as a manifestation of Yankee ingenuity and know-how, it has served as a driving force for the creation and improvement of American industry, it is funded to a very significant extent by the American taxpayer, and above all it is centered on the education of many of the brightest and most talented young people of the United States. MIT is of and for America.

Today, however, in order to serve America well, we must participate in the broader global community. Basic science has always prided itself in being the prototype for true international cooperation, but today this viewpoint and system are being strained—strained because of the increasing economic value of university-generated knowledge and technological concepts.

There are those who look at this country's position on the economic balance scales and call for greater protection of our ideas, especially those having to do with science and technology. Some look at this country's troubles in the world marketplace and are quick to blame our overseas competitors. Others cast the issue into the framework of Pogo Possum's famous saying: "We have met the enemy, and he is us." And still others quickly respond along the lines of Robert Reich, who asks, "Who is us?"—that is, in this day and age, what defines an American corporation?

Clearly, we must be concerned with this nation's economic well-being. We must not, however, endanger the very essence of our institution by retreating into simplistic forms of techno-

nationalism. To draw boundaries around our institution, to close off the free exchange of education and ideas, would be antithetical to the concept of a great university. The list of nations that, at difficult historical moments, closed their universities to the outside world is not one we would be proud to join.

This does not mean that we could not, on occasion, establish special programs directed at the solution of national problems. However, any such programs must also fit one fundamental rule: All students, once admitted to MIT, must be able to participate fully in our educational and research programs, without regard to their citizenship.

In my view, a much more important concern of MIT should be the establishment of programs to ensure that our students are educated in such a way as to prepare them to lead full, responsible lives as world citizens. It is time we made the matter of international context and opportunity an integral part of an MIT education.

The Changing Face of America

Just as we develop new connections among nations, so too must we seek new connections within our own. The face of America is changing significantly and rapidly. Our society is increasingly pluralistic, yet our connections across racial, ethnic, and sometimes even gender boundaries are frayed. Securing America's promise for all remains a crucial goal. The nation's potential will not be fully realized until all racial and ethnic groups have full opportunity to realize their own potential and, in doing so, to contribute fully to the health and vigor of our society.

MIT has traditionally educated engineers, scientists, and others to develop technologies, lead businesses, and serve as professors, researchers, and scholars. To continue this leadership in the era ahead, we must better reflect the changing face of America in our students, faculty, and staff.

We can clearly see such changes in our undergraduate population—thanks to the leadership, commitment, and concerted effort of many here with us today. Among our graduate students and our faculty, however, we see far less evidence of this change as yet. We must double and redouble our efforts to attract the brightest and best from all races, both women and men, not only to our undergraduate program, but to our graduate school and to our faculty. There are many social and historical forces militating against success in this endeavor. It will require renewed commitment on the part of each of us to identify and recruit these scholars and, once they are here, to do our part to see that they attain their full potential.

As one step, we will begin implementing during the coming weeks a program proposed by the Equal Opportunity Committee to recruit more women to our faculty. And we will reaffirm and reinvigorate our policies and programs for bringing more underrepresented minority members to our faculty. As we succeed—and in order to succeed—with these and other efforts, we must work to ensure that MIT is a place that respects and celebrates the diversity of our community. Just as we celebrate learning about the physical universe or the political and economic worlds or the creative arts, so must we celebrate learning about, and from, each other. Such change is rewarding, but it is seldom easy. During the years ahead we must refuse to let the centrifugal forces of intolerance and injustice pull us apart. We must be held together by respect for the individual and by a commitment to the values we hold in common.

Education: To Move a Nation

Just as we as individuals are part of an interwoven social fabric, so too is MIT part of an interdependent educational system—one that begins before kindergarten and extends through post-doctoral studies. Within this system, America's colleges and

universities stand as national treasures. But the strength of these institutions, and thus of our society, is imperiled—imperiled by the state of our primary and secondary schools and imperiled by the declining interest and ability among our young people to pursue rigorous advanced studies, particularly in science and engineering. These trends must be reversed.

It is my firm belief that national educational strength is the essential prerequisite for economic and social prosperity. Education can move a nation; the future belongs to those who understand it. At all levels, active, informed participation in our economy and our democracy now requires an ability to understand basic scientific and technical concepts. And yet, American popular culture pushes us in the opposite direction. We need no less than a change in the culture of this country, a revolution in attitude about the importance of education and, in particular, of scientific and mathematical literacy.

Until we as a nation wake up to the fact that we must increase our investment in the growth of human capital—that is, people and ideas—our educational system will spiral downward, pulling our economy and our way of life with it. This is a danger of the first magnitude and we must all work to address it.

Thirty years ago, MIT played a key role in launching a nationwide wave of education reform in the sciences. The time has come again for us to place our expertise and stature in the service of a major national effort to rebuild the strength of science and mathematics in American schools. I believe that MIT not only can but must draw on its special strengths to help renew effective, accessible education for the young people of this country.

An MIT Education for the Future

The education that we most directly influence, however, is the education of our own students. Among them are people whose

passion is to engineer a better world; among them are people with a particular, concentrated brilliance; among them are profoundly creative people who tread new and different pathways. We are gifted with some of the very brightest young people of our nation and of the world. It is through these students that MIT will have its greatest influence on the world of the future.

In recent years, our faculty has been involved in a long-term review of the undergraduate program. The intensity of this review is testimony to the fact that education, and particularly undergraduate education, is at the very core of MIT. No one has been more engaged with these matters over the years than our engineering faculty—indeed, the engineering curriculum in this country was largely developed by MIT faculty in the 1950s and 1960s. They spearheaded the infusion of basic science into engineering education and practice.

The results were astounding: We produced engineers who created a revolution in computing and communication, developed vehicles to explore outer space, and started not only companies but entire industries based on high technology. While this curriculum has been continually refreshed, its fundamental approach and content have remained essentially unchanged for thirty years. The world in which engineering is practiced, on the other hand, has changed dramatically and rapidly.

Take, for example, the decline in the United States' ability to compete in the world marketplace for manufactured goods. The reasons for this decline are complex, but a major issue has certainly been the attitude of industry and of universities toward the design and manufacture of consumer products. We need to infuse our engineering students with an increased respect for and enjoyment of effective, efficient, and socially responsive design and production. Today, we must prepare engineers who have the self-discipline, analytical skills, and problem-solving abilities so highly valued in MIT graduates, but who are also prepared for

the challenge of production and leadership in the world marketplace of the next century.

This is but one of the challenges to engineering education. But it is indicative of the concerns that face our faculty as they design a curriculum that will serve our students well into the twenty-first century. They will do so in the setting of this research university: a setting in which the unique blending of graduate education, undergraduate education, and research creates unparalleled opportunities for learning and for discovery—a setting that keeps both our education and our research forward-looking and robust.

All do not agree with this view. Many believe that our mission has become distorted and that education has been lost in our desire and responsibility to excel in research. This is clearly a central issue for MIT—one that must be openly discussed in all corners of the Institute. This fall, as an event of the Inaugural year, we will hold a major colloquium on the topic of teaching and learning within the research university. I intend this to be a no-holds-barred debate that will illuminate our efforts to shape the future of education at MIT.

Educational success at MIT depends, above all else, on the commitment and inventiveness of our faculty. Excellence in undergraduate teaching must be rewarded and encouraged. To this end, we are establishing an endowed program to recognize faculty members who have profoundly influenced our students through their sustained and significant contributions to teaching and curriculum development. A select number of faculty will be appointed as Faculty Fellows, each for a ten-year period, and will receive an annual scholar's allowance throughout their appointment. The first Fellows will be appointed this year, and we expect their ranks to build to at least sixty during this decade.

The strength of an MIT education is its depth and intensity. Our graduates value above all else their self-discipline, their

analytical thinking skills, and their confidence to take on great challenges. Today, science and technology, culture and policy, industry and government, production and communication, are interwoven as never before. The nation needs broadly educated young men and women to be leaders of the next generation. An understanding of science and technology is surely part of what such leaders must possess. Similarly, those who practice science and technology need an ever-greater understanding of the world in which they will work and must be able to contribute wisely to policies affecting the development and uses of technology.

What does this mean for education at MIT? Surely it means a careful balance among the humanities, arts, and social sciences on the one hand and mathematics and the physical and life sciences on the other. And it means a continuing look at our departmental programs to ensure that—in content and approach—they give our students the best possible foundation for intellectual growth and professional achievement.

Our campus should be a place where humanistic and artistic scholarship and creation can flower in unique and important new ways. I further believe that we at MIT have an unusual opportunity for the humanities and engineering to enrich each other. While the continuum from the humanities to the natural sciences has long been recognized, the continuum from the humanities to engineering is less well explored. In general, such exploration has been hindered by a utilitarian view of the humanities and social sciences on the part of many engineering educators, and by a lack of appreciation of the intellectual content of modern engineering by many humanists. An MIT education should enlarge an individual's choices—and so should include a common experience in science and mathematics; a serious exploration of the humanities, arts, and social sciences; and a continuing conversation among these fields.

I believe that the creative tension generated by these varying interests and cultures can serve us well as we continue to review and renew our undergraduate programs. We have a common currency of excellence and creativity—regardless of field—that will enable us to develop new modes of inquiry and teaching that make the most of the unique intellectual community that is MIT. We have a special set of talents and focus that give MIT its distinctive character. By building on these special strengths, MIT will contribute in rich and often unique ways to the times and the nation's needs.

We should not expect to be all things to all people. One of the strengths of the American educational system is the great variety of public and private colleges and universities. This condition allows for, and indeed demands, experimentation, variation, cooperation, and competition. The resulting synergy is the yeast that keeps our system strong.

Rebuilding Trust in Science and Technology

For four decades, the American research universities have served this nation exceedingly well. From virtually any perspective, they have paid enormous dividends in return for the public's trust and investment, dividends in the form of educated leaders in academia, business, and government; of advances in medical care and nutrition; of national security; of new and revitalized industries; of increased understanding of our physical, social, and natural worlds. But today, the American public is calling into question the value of our research universities and no longer tends to view science and technology as the foundation of progress. The public's attention is caught not only by the debate over the costs and quality of undergraduate education but also by the debate over the costs and conduct of research.

The doubt of the moment, however, must not be allowed to weaken the basic concept of the American university system, one that is universally recognized as being the best in the world. This system is founded on a social contract with the American public and enhanced by partnerships with government and industry. We cannot keep our flexibility, our vigor, our quality—as a nation or as an academic community—by taking this partnership for granted. We need to rebuild trust in this nation’s research universities and its scientific enterprise. We must ensure that the foundation of scientific and scholarly research is secure. What is this foundation? Jacob Bronowski stated it with deceptive simplicity when he wrote, “The end of science is to discover what is true about the world.”

In seeking scientific truth, ideas and hypotheses are debated, tested, proved, disproved, revised, built upon, or rejected. This activity is carried out by researchers in different laboratories, in different universities, indeed in different countries. This is what makes science, indeed most scholarship, simultaneously an individual and a communal activity. And it is why we have usually been able to rely on this system to detect and correct error. Like all human endeavors, science is not, and cannot be, totally free from error or even occasional abuse. And so it rests upon us—as scientists and scholars—to do a better job of strengthening, continually renewing, and transmitting our system of values.

Great teachers impart and stimulate the passion, excitement, and beauty of intellectual endeavor. But it is equally important that we impart and stimulate the meaning of, the necessity of, and the passion for the pursuit of truth with integrity and ethical rigor. But whatever we say, ethical lessons will be taught primarily by the ways in which we undertake our own scholarly activities.

These lessons will also be conveyed by the ways in which our institutions handle problems if they do arise. How we deal with alleged misconduct will also affect the strength of society’s con-

confidence in and regard for our universities and colleges and for the enterprise of science. We have heard great outcries—for and against—the policing of science. Our response as an academic community must not be one of knee-jerk defensiveness against our critics. Rather, we must engage seriously with our thoughtful critics as well as with our colleagues as we develop ways to continuously foster academic integrity and deal forthrightly and fairly with problems when they arise. If we are not able to do so, we can be sure that others will be only too glad to do it for us.

Public confidence in our universities must be fully restored. Our social compact must be reestablished. But in the discourse required to do so, we must avoid the trap of justifying all that we do on utilitarian grounds. Clearly, we have been great contributors to the nation's economy, and this must continue to be a cardinal element of MIT's mission. But we must take care not to over-emphasize these contributions as the justification for investing in universities. If we overuse such arguments, we might unwittingly endanger our traditions of intellectual excellence, innovation, integrity, openness, worldwide service, deep scholarship, and independent criticism. Ultimately, our contributions to social progress and well-being rest on our ability to steer our own course, with imagination and intellectual daring.

MIT: Shaping the Future

What then is my vision of MIT a decade hence?

MIT will be a preeminent wellspring of scientific knowledge and technological innovation. MIT will foster the pursuits of individual scholars, whose work so often leads to truly fundamental discoveries. We will be known for our ability to establish new and effective methods for analyzing complex and pervasive issues facing the nation and the world. In an invigorated partnership with industry, the government, and other educational

institutions, we will contribute profoundly to their solution. MIT will be known for educating engineers who combine the spirit of innovation and invention with a passion for the highest quality and efficiency in design and production.

MIT will better reflect in our students, faculty, and staff the changing face of America. We will find ways to instill the excitement and romance of science and mathematics in new generations of young people. MIT will spearhead efforts to rekindle our nation's belief in the importance of scientific research and education. We will have found renewed commitment to the deepest values of the academy. MIT will stand for integrity in all that it does. MIT will serve our nation well, but also will be of and for the greater world community.

Above all, the Massachusetts Institute of Technology will be a place to which the brightest young men and women will come for their educations. They will be able to attend MIT regardless of their financial circumstances. They will be taught and counseled by dedicated teachers who themselves define the leading edge of human knowledge and invention. Their education will be robust: deep in scientific content, yet providing the flexibility and learning skills to serve them well in ever changing and expanding circumstances. They will be attuned to the complexities of their world, a world that they will help to change. Through that wonderful blend of undergraduate education, graduate education, research, and creative activity that is MIT, our students will be enriched and they, in turn, will enrich the Institute.

Mens et manus: With mind and hand we set forth. Our promise will be secured by the collective energies and wisdom of those who are drawn to this great magnet for intellect and creativity. Together, we will give shape to the future—the future of MIT, our nation, and our world.